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The mixed blessing of Mode 2 knowledge production

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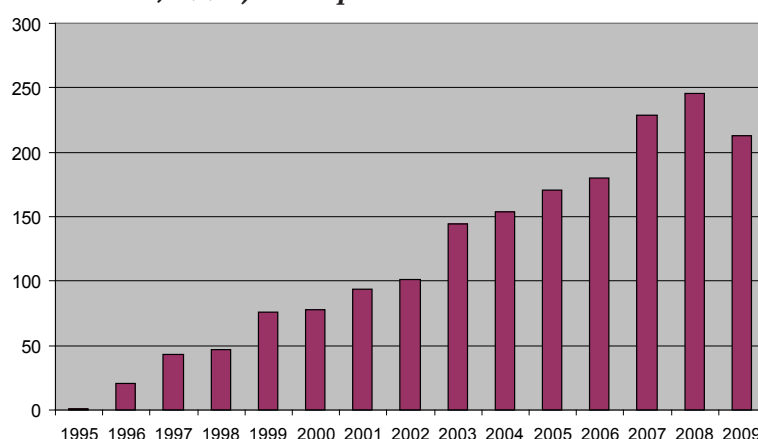
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The notion of Mode 2 knowledge production (Gibbons et al. 1994, Nowotny et al. 2001) already has a remarkable history. It was launched fifteen years ago to capture the ongoing changes in the world of science, science policy and the knowledge economy at large. While it is not the only attempt to make sense of the change, it definitively is the most popular. Since its publication in 1994, 'The New Production of Knowledge' (Gibbons et al. 1994), which has coined the notions of Mode 1 and Mode 2, has received almost 1900 citations in scientific journals (see Figure 1). It is a blessing that it has helped

both scholars and policymakers to get a grip on the profound changes going on in contemporary science systems. But the concept of Mode 2 knowledge production also proved to be a mixed blessing by creating confusion and by conflating interrelated yet independent trends.

In our 2008 review of literature about changing science systems, we identified and discussed a number of problems related to the concept of Mode 2 knowledge production (Hessels & van Lente 2008). We concluded that most of them can be summarized under two

Figure 1: Number of citations of *The New Production of Knowledge* (Gibbons et al., 1994) in Scopus¹



¹ Scopus search on June 14th 2010. Total number of citations (including 2010): 1879. The apparent decrease in 2009 is probably due to the delayed publication of some journals.

headings, limited empirical support and conceptual weaknesses. First, there is no (fully) convincing evidence available for the claim that science is

indeed increasingly characterized by the five features that together define Mode 2 knowledge production. For some of these attributes there is quite some empirical support (such as the increasing heterogeneity of science), but some other are disputed, such as the claims about novel quality control and the increasing reflexivity of knowledge production. Second, the notion of Mode 2 and the concomitant diagnosis is poorly embedded in sociological literature, and questions have been raised about the mutual coherence of its five constitutive features.

Two papers published in a recent issue of *STI-Studies* (Hansen 2009, Kurath 2009) can be read as attempts to address these two problems. Janus Hansen outlines a possible theoretical enrichment of the debate about Mode 2 by introducing the rich tradition of Luhmann and other systems thinkers; Monika Kurath provides an empirical analysis of the social robustness of nanoscience and -technology (NST) governance arrangements. Both papers, we think, testify to the status of Mode 2 as a mixed blessing.

Reaction to Kurath

The rise of nanosciences and -technologies (NST) has been accompanied with many promises and concerns regarding the economic and societal potential of this emerging field (van Lente & van Til 2008). In many countries funding schemes for NST have been launched in the last decade, as well as attempts to anticipate and regulate possible outcomes. Kurath has made a timely overview of the various approaches, under the heading of public engagement, and draws on the Mode 2 ideas on 'social robustness' to assess these attempts. The outcomes of Kurath's analysis (2009) are surprising. Of all fourteen self-regulatory and soft-law approaches, and all six public engagement projects she has investigated, only three score positively on her social robustness scale,

and none of them scores really high. For example, both the UK Responsible Nano Code 2008 and the EU Nanologue 2005-2006 score negatively on the criteria 'stability' and 'acceptability'.

This is surprising because the need for socially robust knowledge is one of the key claims of the influential Mode 2 diagnosis, and the governance of NST can be expected to be a very suitable setting for it. With its high uncertainty about potential risks and benefits and the high stakes involved, NST deserves careful governance. Governments, industry and the other actors involved can be expected not to rely on conventional policy instruments. To put it in stronger terms: if there is one technological domain deserving to be handled with the most innovative, participatory and robust approaches available, it is NST. And yet, as Kurath's results seem to imply, these attempts are all failing.

Does this mean that NST governance is still following a traditional modernist approach, characterized by limited accountability and democracy? In our opinion there are two explanations for Kurath's surprising outcome, a conceptual and an empirical one. First, the conceptual explanation may be found in the way Kurath has used the notion of social robustness in her analysis. While this notion was introduced to characterize knowledge and knowledge production, Kurath applies it to governance schemes. In principle it makes sense to think about socially robust governance as well, but this requires a careful reconsideration of the definition of social robustness (see also Rip, *this issue*). The paper, however, directly translates the characteristics of socially robust knowledge as presented by Nowotny et al. (2001) into five 'criteria' of social robustness and uses them as criteria of governance schemes. Kurath pays little attention to the differences between a research project and a governance arrangement. Characteristics such

as 'stability' and 'acceptability' have quite a different meaning in these two different contexts. The conceptual shift leads to various difficulties, for instance to the paradoxical situation that the stability of a *soft-law* governance scheme is measured by the degree to which outcomes are 'enforceable'. Kurath could have stayed closer to the Mode 2 ideas of social robustness, if she had chosen to analyze governance for socially robust nanosciences and -technologies (NST) instead of the social robustness of NST governance.

The empirical explanation for Kurath's surprising findings would be the discrepancy between the popular and innovative ideas about social robustness that have inspired the various participatory and democratic governance arrangements in the first place, and the inert practices of science and technology governance that inhibit their implementation. Clearly the use of social knowledge and mutual learning is not a straightforward 'instrument' but increases the complexity and unpredictability of the process. This type inertia can be compared to the phenomenon we observed in the dynamics of academic research practices. Our fieldwork on Dutch university research shows that funding sources provide incentives for researchers to promise strongly contextualized research, but that the limited rewards for fulfilling these promises almost nullify these incentives (Hessels et al. 2009). In practice the dominant reward structure of university research is not compatible with all attributes of Mode 2 knowledge production and it exerts a conservative force on the dynamics of university research. Research evaluations, ruled by bibliometric quality indicators, favor traditional forms of knowledge above socially robust knowledge. They typically give most credits to mono-disciplinary achievements that can be published in high-impact scientific journals (Weingart 2005). The criteria ruling formal eval-

uation procedures also shape informal processes of gaining credibility and building reputations. As a consequence, transdisciplinary research, or strong engagement with societal stakeholders yields little recognition. In a similar vein, the pressure for accountability of NST governance may also indirectly restrict the possibilities for more democratic governance arrangements: participation may simply be too expensive.

Reaction to Hansen

The diagnosis of Mode 2 can also be enriched with theoretical strands. Hansen (2009) seeks to enrich the discussion with the work of Niklas Luhmann. A central tenet of this framework is the understanding of society as a set of relatively independent systems of communication. To rephrase and enrich the claims about Mode 2, Hansen suggests distinguishing between two levels of social reality: 'societal sub-systems' and 'organizations'. According to Luhmann, societal sub-systems, such as science and the economy, can be seen as self-referential systems, operating by means of mutually exclusive, binary codes of communication, like true/false and payment/non-payment. Although these systems are locked into each other, they are autonomous in their operations. Unlike these sub-systems, organizations have 'members', of which there are 'behavioural expectations'. Moreover, organizations recursively make decisions that shape their identity. Together, the notions of societal sub-systems and organizations would allow an analysis of both stability and change in the ongoing transformation of knowledge production. As Hansen rightfully argues, there cannot be only change and the blurring of boundaries.

The Mode 2 diagnosis, then, can be translated in this framework by the following two claims: (i) the structural couplings between the societal sub-

systems are becoming stronger, for example between science and politics; (ii) new types of organizations are evolving, operating at the intersection of a multiplicity of subsystems, for example technology transfer offices that form a bridge between science and the economy.

Hansen's paper shows that the Luhmannian framework provides opportunities for further analysis of the Mode 2 diagnosis. The concept of Mode 2 suffers from its enthusiastic reception: due to its wide scope and universal appeal, everyone can use the term as he likes, which complicates systematic comparisons. Thanks to its conceptual clarity and coherence, the framework presented by Hansen could facilitate gathering and comparing data about public engagement in different scientific fields and national contexts.

However, to this end, there is still work to do. Hansen's suggestions for empirical research' are rather abstract, and do not provide concrete starting points for scholars willing to adopt his approach. The questions he raises (e.g. 'Where and how are public engagement procedures anchored institutionally?' (p. 85)) are interesting, but they are insufficiently specific. What is lacking is an operationalization of the Luhmannian concepts into empirically measurable indicators. What kind of data should one collect in order to investigate structural couplings between societal subsystems?

In particular, the framework is still open with regard to the cross-national comparisons that Hansen advocates. The three dimensions of political culture borrowed from Jasanoff (2005), should 'serve as a tool to order observations of local or "institutional" specifications into how science interacts with politics, the economy and the legal system' (Hansen 2009 p. 81). However, 'representation', 'participation' and 'deliberation' are quite general characteristics of public engage-

ment in different contexts. Again, what types of data could be used in an empirical analysis of these variables? And how do these variables relate to the Luhmannian subsystems and organizations?

An important characteristic of Luhmann's approach, and ipso facto also of Hansen's framework is that it uses communication as the entrance point for studying social reality. A risk of starting with communication patterns is that practices and agency may remain obscured. With regard to science, one runs the risk of overlooking the content of science and the dynamics of actual research practices. As the success of the field of scientometrics shows, publications can serve as valuable indicators of research practices, but they miss some aspects of the practices as well. Collaboration patterns, for example, are known to be only partly reflected in co-authorships (Laudel 2002). Also content analysis of scientific publications can be deceptive, as researchers may strategically adopt fashionable terms, without actually changing their research activities.

Another possible route to theoretically embed the Mode 2 claims is to put the research practices central. Elsewhere (Hessels et al. 2009) we have outlined, that it is fruitful to analyze the changing research practices with the credibility cycle (Latour & Woolgar 1986). This model, which is rooted in a constructivist tradition, explains how struggles for reputation influence the behaviour of individual scientists. Scientists possess different forms of credibility, which function as resources to be invested and earned back in another form. Conceived in this way, the research process can be depicted as a repetitive cycle in which conversions take place between money, staff, data, arguments, articles, recognition, and so on.

An analysis of this cycle gives powerful insights into the changes in actual

practices of university research. It facilitates investigation of the agency of scientists, influenced by changing structural conditions. It also helps to differentiate the Mode 2 claims for different scientific fields. In some fields, such as Catalysis and Paleo-ecology, the orientation on practical outcomes has strengthened over the past 35 years. In fields like Biochemistry and Cell Biology, however, the traditional academic orientation was conserved and even strengthened by the increased pressure for academic publications. In other words, Mode 2 characteristics are becoming more visible in some fields, while they remain absent in others. Differences between the fields can be further explained by their communication culture, social organization and characteristics of their societal stakeholders.

To conclude

The notion of Mode 2 has proved to be an important step towards both the visibility and the understanding of important trends in contemporary science systems. Yet, it is also a source of questions and confusion. Conceptually, it is still underdeveloped and prone to further refinement. Empirically, its arguments are too brittle and equivocal to be used as a basis for convincing assessments and interventions. In the attempt to address these weaknesses, Hansen and Kurath seem to have divided the enrichment labour. While one focussed on theoretical enrichment, the other made an empirical effort. We would recommend them to join forces. To turn the notion of Mode 2 into a blessing of a better mix, a balanced combination of conceptual refinement and empirical testing is needed.

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